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13. SUPPLEMENTARY NOTES

14. ABSTRACT

Equipment listed in the report was purchased with $126,457 DOD funding supplemented by $14,050 Stanford University cost sharing. It will be used to investigate the interaction of shock waves and detonation waves with fuel sprays.

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15. SUBJECT TERMS

shock waves, detonation waves, fuel sprays

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Apparatus for the Study of Shock Wave and Detonation Wave Interactions with Fuel Sprays

DURIP/Instrumentation Grant Final Technical Report

Ronald Hanson
Department of Mechanical Engineering
Stanford University, Stanford, CA 94305-3032

EQUIPMENT ACQUIRED

The equipment listed in Table 1, Shock/Detonation Wave – Spray Interaction Facility, was purchased with $126,457 from AFOSR Contract F49620-00-1-0196 and $14,050 from Stanford University Cost Sharing Accounts. This contract initially extended over the period 04/01/00 to 03/31/01 and was then extended to 09/30/01.

RESEARCH SUMMARY

There is a critical need by computational fluids modelers for experiments that describe the interaction of well-characterized shock waves with very uniform fuel sprays. This data is needed to guide and validate CFD analyses of air-breathing propulsion systems with these flow elements, such as pulse detonation engines. There are, to our knowledge, no currently operating facilities with the capability to address these fundamental heterogeneous flows using modern optical diagnostics.

The test apparatus purchased will enable investigations of the interaction of shock waves and detonation waves with fuel sprays. The newly acquired shock tube, vacuum support and instrumentation, when used in conjunction with existing diagnostics, will permit the generation of shock waves and detonation waves and their accurate characterization. The real time droplet sizing system will permit accurate quantification of the fuel spray generation process, as well as determination of the post-shockwave spray distribution time history.

Using this new equipment, researchers at Stanford, will now be able to provide details on the attenuation, or growth, of shock waves as they travel through a two-phase flow, details on the spray evaporation time history, and details on the chemical kinetics of the ignition process. This will expand the range of our current studies, as previous experiments in our laboratory have only been able to investigate gas-phase chemistry, and this will expand the available shock tube database from other laboratories, as previous experiments in other laboratories have not concentrated on the production of very uniform fuel sprays in shock tubes.

In addition to the work in Prof. Hanson's group, other researchers in the High Temperature Gasdynamics Laboratory who are working with sprays, including Professors

C. Edwards' and T. Bowman's studies sprays in detonations and meso-arrays, will benefit from the availability of the portable state-of-the-art spray sizer, and the experience in optical diagnostics in two-phase flows gained in the shock tube studies.

TABLE 1: Shock/Detonation Wave Spray Interaction Facility

Item	*Supplier*	*Cost ($)*
Spray Interaction Shock Tube		
Shock Tube	Johansing Ironworks	47,652
End mass and windows	HTGL Shops	21,008
Vacuum support including: linear feed through, gate valves, pumps	Kurt J. Lesker, MDC Vacuum, Varian Vacuum	15,614
Instrumentation including: pressure transducer and gauges	Kistler Instruments, McMaster Carr, MKS Instruments	6,553
Droplet Sizer		
Spraytec RTS5114 real time droplet sizing system	Malvern Instruments	49,680
TOTAL		**$140,507**